# *Koman Dam Albania - Hydraulic model tests for spillways and plunge pool (2008)*

*Milad Daneshvari, Giovanni De Cesare*

*Client: Pöyry Ltd, Zürich*

## *Introduction and objectives*

Koman dam (Figure 1) is located in the Northern part of Albania and is one of the existing dams of the Drin River cascade. It is a concrete face rockfill dam which was constructed between 1980 and 1988. The powerhouse has an installed capacity of 600 MW.

Hydraulic model tests have been carried out in order to test the current state of the spillway No.3 (with maximum capacity of 1900 $m^3/s$) and No.4 (with maximum capacity of 1600 $m^3/s$), to assess the plunge pool geometry and to propose solutions in order to improve the safety of the downstream toe of the dam and stability of the right bank downstream of the dam if necessary.

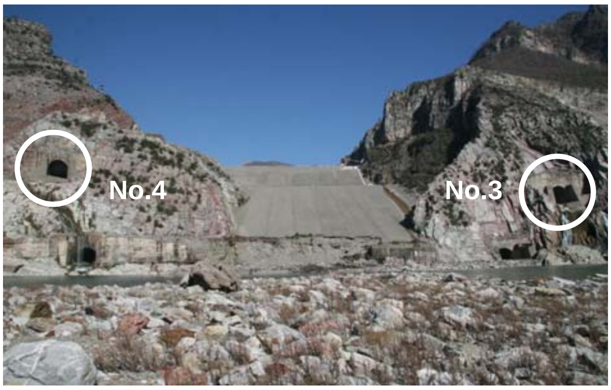


Figure 1 : View of the downstream face of the Koman dam with eroded dam toe and the outlet works

## *Physical model tests*

To study in detail the hydraulic behaviour of the different elements, a representative hydraulic model (Figure 2) with the main parts of the scheme, scale 1:65, was built at the LCH. The model tests had the following objectives:

- To verify the flow in the tunnels and at the spillway outlets for different scenarios,
- To Measure and verify theoretically the jet trajectory and impact zone in the plunge pool,
- To measure the water levels inside the plunge pool,
- To study qualitatively the bed load movement and to assess the scour potential in the plunge pool,
- To study the flow circulation inside the plunge pool, especially in front of the dam toe, considering the possibility of reverse currents and also eddy formations,
- To measure the velocity inside the plunge pool area, especially next to the dam toe and along the right bank,
- To measure the dynamic pressures acting on the dam toe,
- To propose and verify the structural modifications at the spillway outlets where the jet trajectory could be improved

Figure 2 : Front view as a photomontage of the physical model and damaged dam toe

## *Test results*

According to the physical tests, for both spillways the buckets are able to guide the jets appropriately up to 50% of their nominal capacity. For higher discharges (the spillways operating at 75% and 100% of their nominal capacity), the specific discharge increases and reaches values higher than 110 $m^3/s/m$, the buckets are no longer able to guide the flow as theoretically predicted and the jet travel length decreases by 10 to 16 meters compared to the lower discharges.

Thanks to the velocity measurement in the plunge pool, the maximum velocities which vary from 4.5 to 4.8 m/s are reached on the right bank of the river when the spillways are working simultaneously with maximum discharge.

During spillway operations horizontal vortices arrive on the lateral sides of the dam toe. The maximum velocity caused by vortices was observed during simultaneous operations of the spillways with their maximum capacity which was about 4 m/s on the right side.

From the dynamic pressure measurement at the dam toe with different scenarios it can be concluded that one of the principal reasons of dam toe erosion at Koman dam is the waves with 1 to 3 meters amplitude which hit the dam body every 5 seconds.

One alternative (modifying the flip bucket) has been implemented in the physical model on Spillway No.4. Nevertheless it can be concluded that altering the flip buckets could increase the jet travel length by approximately 5 meters, but will neither eliminate nor attenuate the existing flow velocities and wave impact problems at the dam toe and on the right bank.

Finally, when considering the rehabilitation of the dam toe, the new structure must be able to withstand over longer periods as well as with frequent impacts of high flow velocities and strong wave actions. In this sense a permeable material with a proper protecting structure such as a high resistant rip-rap against wave action seems compulsory. Regarding the right bank peninsula separating the plunge pool from the powerhouse tailrace channel, a tailored solution to withstand high velocity water flow must be considered.